Climate services for wind energy

Llorenç Lledó[1] (llledo@bsc.es), Dragana Bojovic[1],Verónica Torralba[1], Albert Soret[1], Nube González-Reviriego[1], Marta Terrado[1] and Francisco J. Doblas-Reyes[1,2]

[1] Barcelona Supercomputing Center, Barcelona, Spain

[2] Institució Catalana de Recerca i Estudis Avançats (ICREA), Spain

Introduction

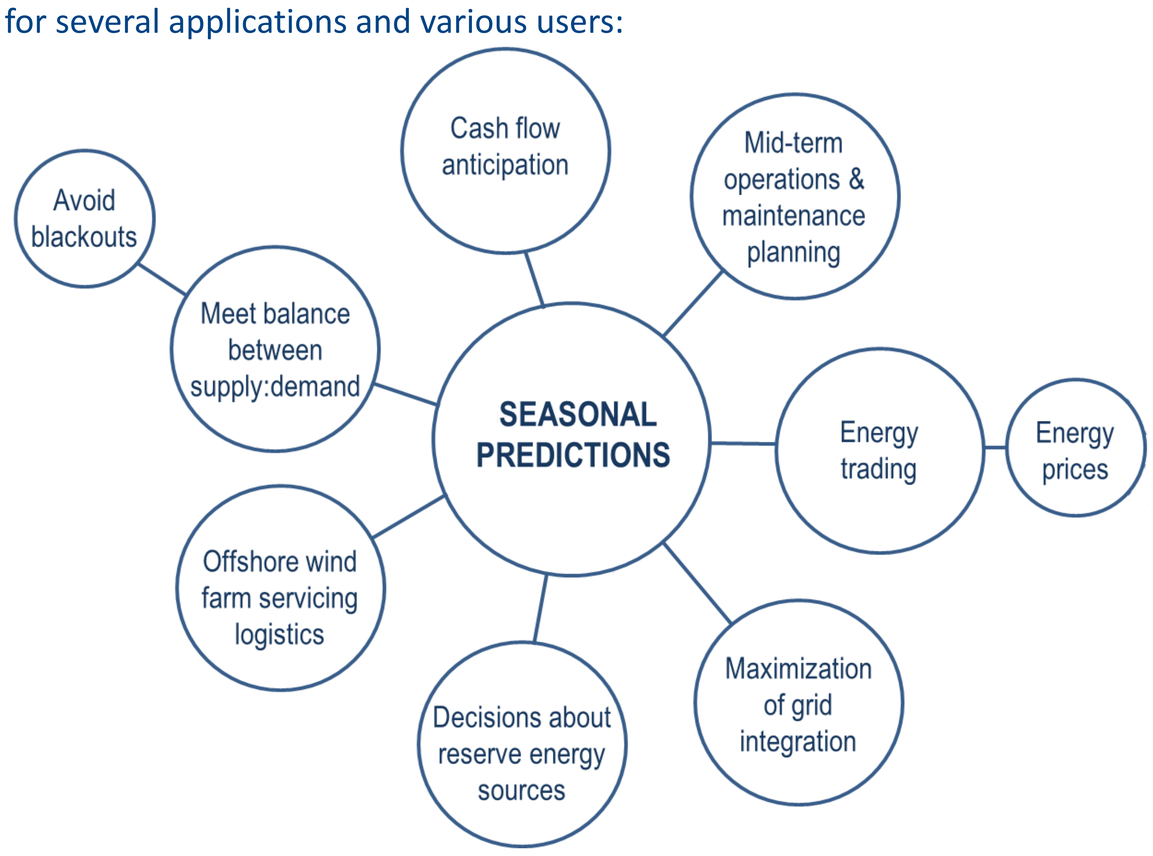
A flexible energy sector, with an increasing share of renewables in the energy mix, needs to be able to adapt to changes in resources availability. CLIM4ENERGY is an on-going Copernicus Climate Change Service project that illustrates how to use both seasonal climate predictions and long-term climate projections to provide relevant information for the energy sector.

Tailored to satisfy user needs and understandings, this knowledge can inform decision-making in this ever-growing sector that can significantly contribute to climate change mitigation and adaptation.

In this context we focus on the application of seasonal forecasts for wind power generation.

Applications of seasonal forecasts

Seasonal forecasts of wind speed and wind energy generation can be useful for several applications and various users:



Co-design approach

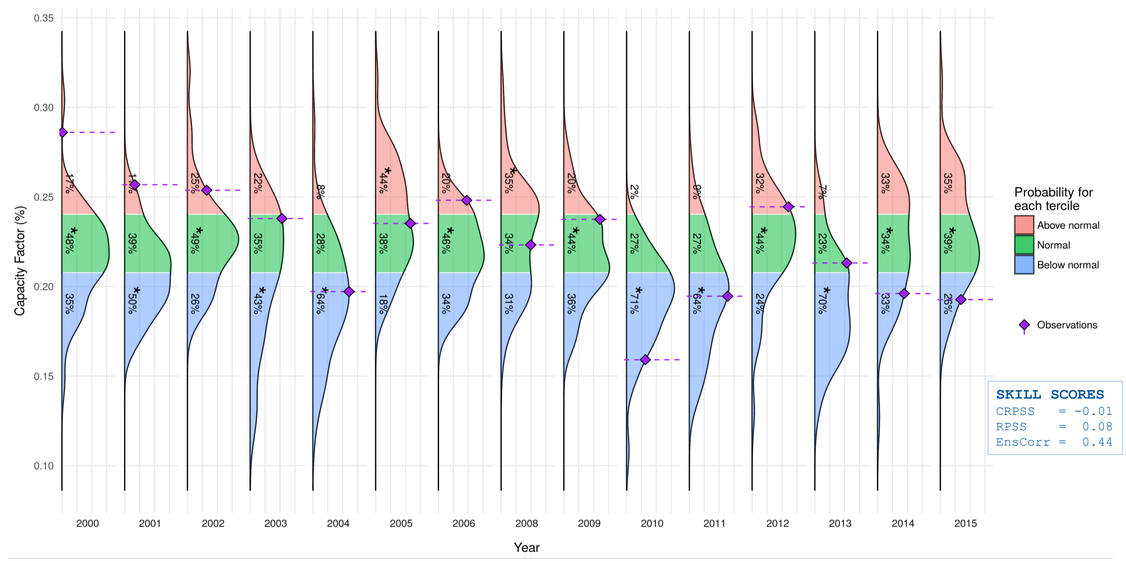
The use of a co-design approach, with the involvement of stakeholders from the very beginning of the process, helps understanding user requirements and shaping the RESILIENCE visualization tool (see bottom panel).

In addition, in close collaboration with EDP Renewables capacity factor emerged as the most useful indicator for assessing wind power production.

Capacity Factor (CF) of an installed wind farm measures how good the meteorological conditions have been for producing energy during a specific period:

$$CF\ (\%) = \frac{Actual\ generation}{Maximum\ possible\ generation}$$

We use seasonal wind speed predictions from ECMWF System4 to provide capacity factor predictions for the next season at least one month in advance. The forecast is enhanced with site specific data provided by the stakeholders. This offers a practical demonstration of this service and allows an evaluation of the forecast quality, including skill scores.



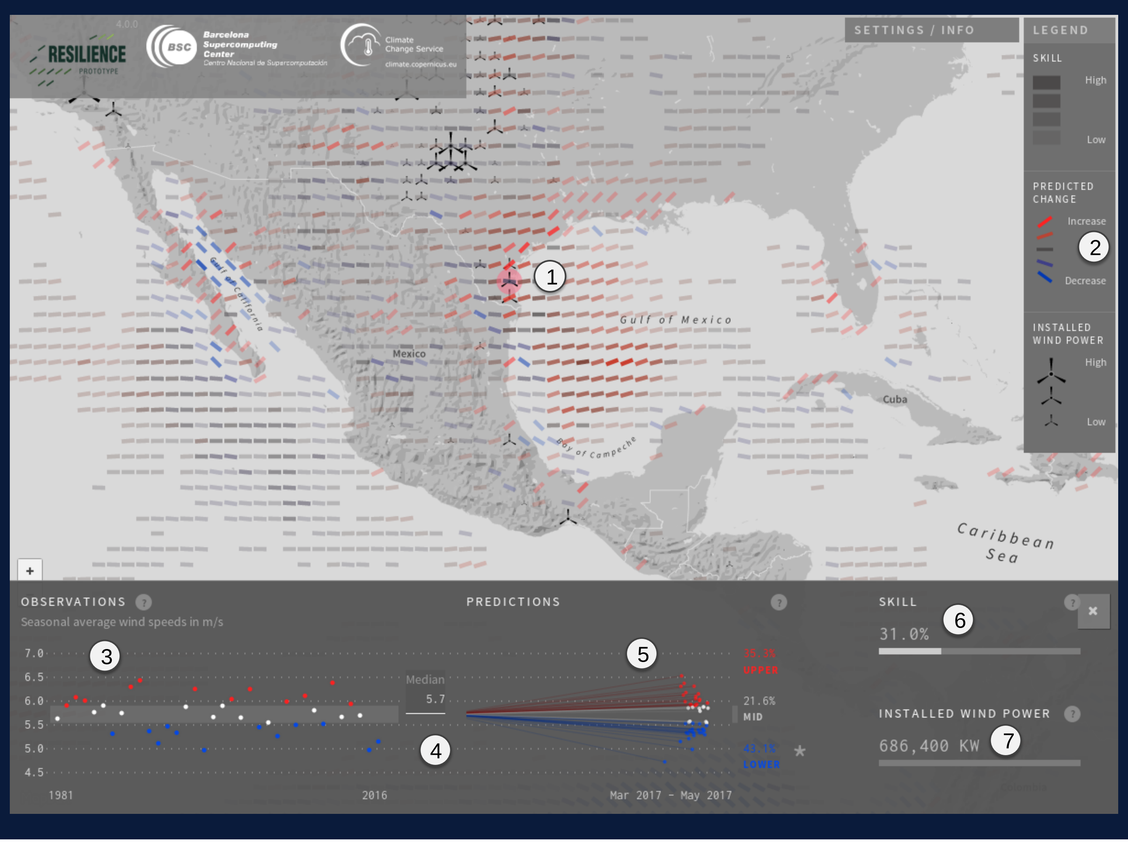
A retrospective probabilistic forecast of capacity factor for JJA of the last 15 years, adjusted using on-site data

Conclusions

The climate service based on seasonal forecasts and climate projections of capacity factor will contribute to a more efficient energy planning, resulting in better informed mitigation measures. Besides mitigation, this service can support adaptation measures of the wind energy sector by providing more accurate information for: resource modelling, encouraging investments from the finance sector; increased turbine availability and minimized production losses from a better operation and maintenance scheduling. All this will favor the adoption and testing of adaptation strategies well ahead of the local impact of global environmental change.

RESILIENCE visualization tool

http://www.bsc.es/projects/earthscience/resilience



1. Selected geographical area
2. Predicted wind speed anomaly. High probability of reduced wind speed compared to climatology in the predicted season is displayed by blue lines pointing bottom right. High probability of increased wind speeds compared to climatology in the predicted season is displayed by red lines pointing top right
3. Observed seasonal average wind speed in the selected geographical area over the last 30 years based on ERA-Interim reanalysis. Observations are split into three categories of equal size (terciles). The third of years with the highest wind speed (upper tercile) is marked in red and the third of years with the lowest wind speed (lower tercile) is marked in blue
4. Median wind speed of ERA-Interim over the past decades
5. Wind prediction for the next season. Overall, 51 different ensemble members were generated, resulting in a range of potential outcomes. The percentage of members in each of the terciles gives the probability for the next season to have lower, equal or higher than normal wind speed conditions
6. The skill measures how well the prediction system has performed over the last 30 years in the selected region. It informs of the expected performance of the forecasts in the future. A skill of 100% would mean that the prediction system performance is perfect, whereas a skill of 0% means that our model is not better than making a guess based on historical data. Prediction skill is expressed through opacity in the map
7. Currently installed wind power in the selected area, which reflects the production capacity in that particular area. Turbine icons of varying size show the overall installed power (generously provided by windpower.net)

CLIM4ENERGY is a Copernicus Climate Change Service project. We acknowledge RESILIENCE and EUPORIAS projects.

Visit CLIM4ENERGY website:

Presented at the 3rd European Climate Change Adaptation Conference (ECCA), 5th-9th June 2017, Glasgow